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The Effectiveness Of Blended Learning Application on Student's Mathematical Problem Solving Ability

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Abstrak

Kemampuan pemecahan masalah merupakan salah satu tujuan pembelajaran matematika yang diamanatkan kurikulum merdeke belajar. Kemampuan ini merupakan kemampuan penting guna membekali siswa dalam menghadapi situasi yang selalu berubah. Pentingnya kemampuan ini justru berbanding terbalik dengan rendahnya kemampuan pemecahan masalah matematika siswa kelas VIII di SMP Negeri 13 Bandar Lampung. Kondisi yang ada, disebabkan penerapan model pembelajaran yang belum mengasah kemampuan tersebut dengan maksimal. Oleh karena itu, riset ini bertujuan untuk mengetahui efektivitas penerapan *Blended Learning* terhadap kemampuan pemecahan masalah matematis siswa. Riset ini merupakan quasi eksperimen dengan desain *nonequivalent control group design*. Sampel penelitian ditentukan dengan teknik *cluster random sampling*, karena populasi dalam kondisi homogen, dengan kelas VIII.1 sebagai kelas eksperimen dan kelas VIII.3 sebagai kelas kontrol yang masing-masing berjumlah 23 dan 27 siswa. Kemampuan pemecahan masalah matematis siswa diukur dengan tes dalam bentuk essai sebanyak 5 soal yang terlebih dahulu telah diuji validitas dan reliabilitasnya. Pengujian hipotesis menggunakan uji *t* dan dilanjutkan dengan uji efisiensi relatif guna melihat efektivitas model dengan sebaran kemampuan pada kedua kelas. Hasil penelitian menunjukkan bahwa *Blended Learning* terbukti efektif terhadap kemampuan pemecahan masalah matematis siswa kelas VIII semester genap di SMP Negeri 13 Bandar Lampung tahun pelajaran 2021/2022.
Kata kunci: Blended Learning, Matematis, Pemecahan Masalah.

Abstract

Problem solving ability is one of the objectives of learning mathematics mandated by the 2013 curriculum until the independent learning curriculum. This ability is an important ability to equip students in dealing with ever-changing situations. The importance of this ability is inversely proportional to the low mathematical problem solving ability of class VIII students at SMP Negeri 13 Bandar Lampung. The existing conditions are caused by the application of learning models that have not been able to hone these abilities to the maximum. Therefore, this research aims to determine the effectiveness of the application of Blended Learning on students' mathematical problem solving abilities. This research is a quasi-experimental design with a nonequivalent control group design. The research sample was determined by using a cluster random sampling technique, because the population was homogeneous, with class VIII.1 as the experimental class and class VIII.3 as the control class with 23 and 27 students respectively. Students' mathematical problem solving ability is measured by a test in the form of an essay as many as 5 questions which have been tested for validity and reliability. Hypothesis testing using t test and continued with relative efficiency test in order to see the effectiveness of the model with the distribution of abilities in both classes. The results showed that Blended Learning proved to be effective on the mathematical problem solving abilities of even semester VIII students at SMP Negeri 13 Bandar Lampung in the academic year 2021/2022.
Keywords: Blended Learning, Mathematical, Problem Solving.

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INTRODUCTION

The main competencies needed in the era of digital global change are skills in solving various problems. A survey conducted by the National Association of Colleges and Employers (NACE) states that graduates who have problem-solving skills are able to compete (Wibowo, 2019). Resources that can compete in the current era of the industrial revolution are resources that can deal with unexpected situations followed by mastery of digital technology.

The main competency demands in the 4.0 industrial revolution are also mandated in the 2013 curriculum until the independent learning curriculum. The main competence in the form of skills in problem solving is the goal in learning mathematics. As stated by the National Council of Teacher Mathematics (NCTM, 2000) that problem solving skills are one of the main basic competencies in learning mathematics, in addition to communication, connection, reasoning, and representation skills. The importance of solving mathematical problems stated by NCTM (2000) is supported by Kurniawan, Raharjo, & Khumaedi (2019) where all three argue that an important competency to prepare a superior generation that is ready to compete in facing the challenges of the 21st century is competence in problem solving.

Competence and skills as a focus of learning from the initial level to university one of which is the ability to solve problems. Problem solving activities equip students with the ability to deal with unexpected situations, using situational analysis skills critically and creatively. NCTM (2000) states that problem-solving activities are not only a goal but also a learning tool/process it self. Learning mathematics provides an open opportunity for students to hone their thinking skills in dealing with different situations. Problem solving as a person's process of integrating knowledge and understanding skills together to deal with a new situation (Krulik and Rudnik, 1995).

Several studies have shown that the abilities acquired by students in problem solving can be integrated in real life (Bell, 1978). Solving problems requires effort, creativity, and knowledge. Characteristics of a situation is called a problem for someone, if someone feels the need to overcome it but cannot immediately find a way to overcome the situation. As stated by Polya (1973) that problem solving as a process or attempt to solve a difficulty that is not so

easily achieved. In the problem solving process, students hone reasoning, thinking skills, and creativity which are important foundations for students to have.

Problem solving as a goal in learning mathematics, as well as a process that students go through and as a skill as a learning outcome/objective (Hendriana, et al, 2017: 44). This activity produces skills for students that can be used and applied in problems outside of mathematics, as well as hone the ability to determine strategies in situations that are not commonly encountered. It can also be seen as a skill that requires strategy and knowledge. As stated by Agustami, Aprida, & Pramita (2021: 225) that problem solving ability is the ability of students to solve something that is unpredictable and non-routine. In the implementation in the classroom, the teacher must develop the types of problems that not only require knowledge and results, but also problems that can be worked out through the process. This problem is at a level that is not often encountered by students.

Students are said to have good mathematical problem solving skills, if they master this ability indicator. There are several expert opinions regarding indicators of mathematical problem-solving abilities that describe students' abilities. Table 1 describes indicators of mathematical problem solving ability according to Sukayasa in Kusmayadi (2012: 56).

Table 1. Comparison of Indicators of Mathematical Problem Solving Ability

Indicator of Mathematical Problem Solving Ability		
Polya (1985)	John Dewey dalam Swadener (1985)	Krulik & Rudnick (1995)
1. Understanding the problem)	1. Recognition	Read and think
1. Devising a plan)	1. Definition	Explore and plan
	2. Formulation	Select a strategy
3. Carrying out a plan	4. Test	Find an answer
4. Looking back	5. Evaluation	Reflect and extend

In more detail related to the four steps that must be taken in the process of solving the problem Polya (1973) includes the ability to: 1). Understanding the problem (understanding the problem) can be indicated by the ability to show data, if there is a picture of how it is depicted, to the relationship from the main part of the problem, 2). Making a strategy/plan (devising a plan), which can be indicated by the ability to prepare a settlement plan if you already know in general how to solve it, 3). Completing the plan (carrying out a plan), which is indicated by the ability to carry out the previously designed completion plan, 4). Re-checking the results and processes (looking back), as the final step of the activity and indicated by checking the

correctness of the answers that have been obtained. This step can be done by examining the rebuttal, looking for other alternative solutions, to see if the strategies used can be applied to other questions.

Various steps of solving mathematical problems, honing students' abilities to see problems well, to finding solutions to problems. This ability also sharpens students' analytical and critical skills towards a problem. Of course this is very necessary in solving other problems in simple or complex life.

The mathematical problem solving ability of class VIII students at SMP Negeri 13 Bandar Lampung is not directly proportional to the importance of this ability. The results of the initial study showed that it was difficult for students to solve non-routine questions. The difficulty of students in solving non-routine problems is seen both during learning or during exams where there are several non-routine questions. The facts are reinforced by the results of non-routine problem solving from class VIII students, where students find it difficult to understand the problem, make strategies (determine the concepts used to solve problems), and perform calculations based on the strategies chosen correctly. Most of the rest (80% of the total number of students) did not understand the meaning of the questions resulting in difficulty for students to determine the right solution strategy and calculation errors occurred. In addition, UPT SMP Negeri 13 Bandar Lampung is a school with low numeracy literacy skills (Dapodik data, School Self-Evaluation (EDS), trends in national exams/assessments).

The low mathematical problem solving ability of grade VIII students at UPT SMP Negeri 13 Bandar Lampung also occurs due to the lack of opportunity to develop this ability in the post-pandemic transition period. Changes in the process due to the pandemic, of course have various impacts. One of the perceived impacts is a decrease in students' mathematical abilities. As stated by Anisah, et al (2021) that during the change in the implementation of face-to-face learning to online it causes a decrease in student learning success, one of which is in the cognitive aspect (less deep understanding of students). Learning with e-learning also brings various impacts, one of which is success in learning, this is stated by Wardani, Toenlio, & Wedi (2018: 13). The differences in the learning styles of students are also not fully fulfilled through online learning that is carried out. In addition to learning styles, through e-learning, students and teachers meet very little face-to-face so it is difficult to socialize (Wildavsky, 2001). Thus online learning during the Covid-19 pandemic has an impact on post-pandemic learning that requires solutions.

One of the efforts that can be done to overcome the problems related to the low ability to solve mathematical problems is through the application of Blended Learning. Noviyanti, Sugiharta, & Farida (2019) stated that the application of Blended Learning can improve problem solving abilities, minimize problems of time, distance, and place. Students are also given the opportunity to study online and offline. Howard (Chaeruman, 2019) explains that Blended Learning is defined as two learning settings, namely synchronous and asynchronous learning. Synkonus is defined as learning that is carried out simultaneously at the same hour, even though it is in a different location. This means face-to-face and online. Asynchronous is a teaching and learning activity on the same material, but in a different place and time (Heinich et al., in Chaeruman 2019).

Blended Learning is one of the answers to the demands of an independent curriculum in an effort to digitize schools. This model integrates the role of digital technology in learning. Blended Learning also allows students to learn independently without being bound by space and time. Utilization of e-learning in Blended Learning can be used for assignments, continuing unfinished material, and media for teacher and student discussions. Munir (2017: 63) states that Blended Learning can provide students with space for independent, sustainable, efficient, and interesting learning.

The implementation of Blended Learning, which is suitable for use in post-pandemic face-to-face conditions, is one that combines face-to-face learning with student and teacher activities to access the internet and other implementation models by using online materials without internet. Blended Learning used in this research also uses a combination of face-to-face learning with online activities (internet access). This model is as stated by Husamah (2014: 22), regarding the implementation of Blended Learning which is illustrated in Figure 1.

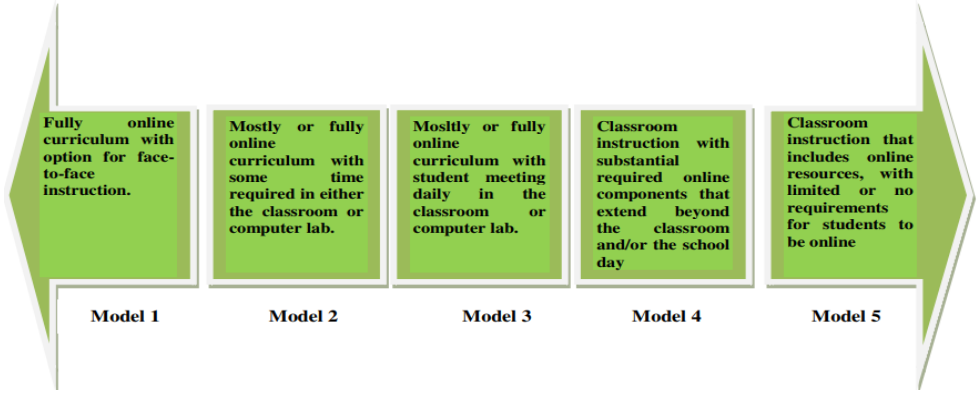

Figure 1. Several Blended Learning Implementation Models

Blended Learning according to Chaeruman (2019: 3) when viewed from the perspective of space and time (synchronouscity) is divided into two, namely synchronous learning and asynchronous learning which is illustrated in Figure 2.

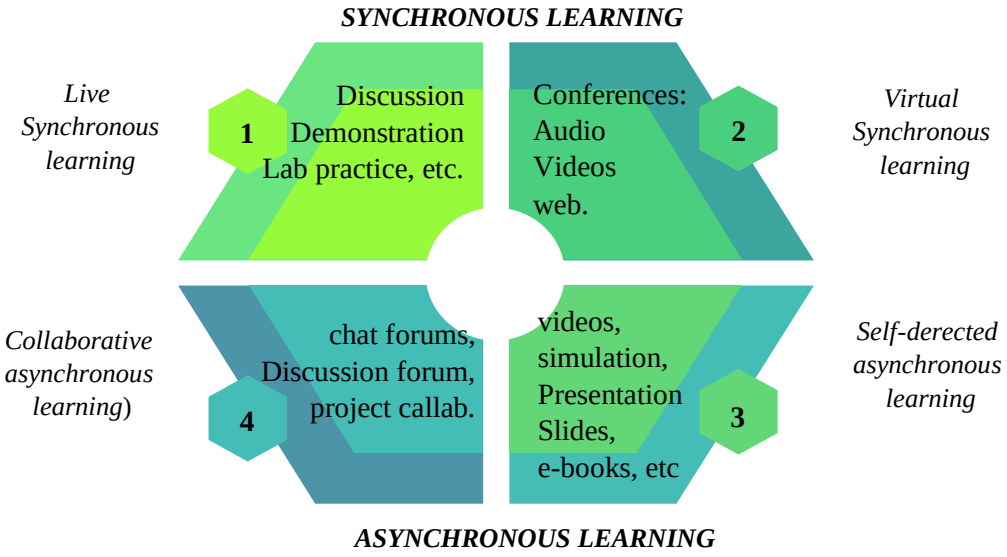

Figure 2. Blended Learning Study Room Illustration

The application of the Blended Learning model according to Idris (2011: 62) is where face to face learning with computer-assisted teaching methods both offline and online is combined. To overcome the current post-pandemic learning loss, Blended Learning is certainly the right choice. The combination of offline and online in this model can maximize learning through their respective advantages. This means that the advantages of learning in a network that are not bound by space and time, make students able to repeat the learning material. The role of the teacher is also felt by the students. Strengthening of students' mastery of material can be maximized when face to face. Thus, Blended Learning can be used as an approach in these conditions.

The breadth of learning opportunities in Blended Learning provides opportunities for active students in conditions that meet their learning styles, meaning that learning can be student-centered. If students who tend to be difficult to be active in face-to-face learning, can be more flexible in online learning and vice versa. This means that the Blended Learning model is able to create student-centered learning (Vernadakis, et al. in Yanti, Farida, and Sugiharta, 2019). Face-to-face learning in this model reinforces online activities. Of course this makes students' mastery of learning materials stronger. The interaction between educators and students can be enhanced in combination with this model. Strong students' understanding of teaching materials, of course, very useful in solving mathematical problems. This is why, the Blended Learning model is thought to be effective in problem solving abilities.

In line with research conducted by Yanti, Farida, and Sugiharta (2019), Payadna and Jayantika (2021) stated that the application of the Blended Learning model is very suitable in the 21st era which demands students' ability to solve problems. The research conducted has differences with previous research, where the effectiveness is not only from differences in the achievement of students' mathematical problem solving abilities, but also by looking at differences in the distribution of values through comparison of variances. The measured ability indicators also have differences with previous studies.

The application of Blended Learning is considered to be able to overcome the low ability to solve mathematical problems. Blended Learning was developed with the advantages and disadvantages of face-to-face learning and online learning. The combination of the two certainly gives students the flexibility to study the subject matter. Learning discussions can also be carried out regardless of distance or time. Teaching materials can also be easily shared and added with the help of the internet. Of course, the various advantages of the combination of Blended Learning make learning easy to control and measure. Students' abilities are also increasingly emphasized in this dualism of learning. This is the reason behind conducting research on the effectiveness of the application of Blended Learning.

RESEARCH METHOD

This research is a quasi-experimental research that intentionally provides treatment in the form of the application of Blended Learning and is reviewed how effective it is, where the Blended Learning model in class VIII.I as the experimental class with 23 students and class VIII.3 with 27 students as the control class applies conventional models. The experimental design used is as shown in Table 2.

Table 2. Nonequivalent Control Group Design

Experiment Class	Treatment	Post-test
Control Class	---	Post-test

Source: (Sugiyono, 2021)

The research population was 289 students (all students of class VIII). The research sample was taken using a cluster random sampling technique with a lottery procedure, considering that the population was in a homogeneous condition. The treatment given is the application of Blended Learning, with online activities focused on collaborative discussions, problem solving, and independent learning using e-learning media (google classroom). Face-to-face is used for reinforcement, discussion, and presentation. After the treatment, a post-test was given to

measure mathematical problem solving skills, using a test in the form of a description that had been tested for validity and reliability with the results in Table 3.

Table 3. Recapitulation of Validity and Reliability Test Results

1. Validity Test Results				
No. Test Item	Value r_{xy}	t_{hitung}	t_{tabel}	Description
1	0,85	7,69	1,71	Valid
2	0,86	8,10		
3	0,91	10,65		
4	0.81	6,62		
5	0,85	7,69		
2. Reliability Test Results				
	r_{11} = 0,90			Reliable

Testing the research hypothesis using a t-test (right side test) at a significant level of 5%, by first conducting an analysis prerequisite test in the form of a data normality test (Lilifors test) and a homogeneity test of variance, which shows that the sample comes from a population that is normally distributed and secondly The data have the same variance (homogeneous). After testing the hypothesis, it is followed by testing the effectiveness of using the Blended Learning model on students' mathematical problem solving abilities using the relative efficiency formula θ_2 (estimator 2) against θ_1 (estimator 1).

RESULT

The results obtained from the quasi-experimental implementation obtained from the posttest in both groups can be seen in Table 4.

Table 4. Distribution of Mathematical Problem Solving Ability

Data Distribution	Experiment Class	Control Class
Minimum Value	36	13
Maximum Value	96	89
Mean	74,34	48,95
Median	80	50
Mode	80	47
Standard Deviation	16,34	22,12
Total students	23	24

Based on Table 4, it can be seen that those who apply the Blended Learning model have an average value above the KKM value that has been set for mathematics learning in class VIII, which is 70, which is 74.34, while in the control class it is still below the KKM, which is 48.95.

This means that most of the students' scores in the experimental class have reached the minimum limit set. If it is described according to its qualifications, it can be seen as shown in Table 5.

Tabel 5. Description of the Qualification of Students' Mathematical Problem Solving Ability

Score	Qualification	Frequency		Percentage	
		Experiment Class	Control Class	Experiment Class	Control Class
85,00-100	Very good	8	2	35%	8%
70,00-84,99	Well	6	3	26%	13%
55,00-69,99	Enough	6	4	26%	17%
40,00-54,99	Not enough	2	8	9%	33%
00,00-39,99	Very less	1	7	4%	29%
Total		**23**	**24**	**100%**	**100%**

The distribution of the research data was then analyzed in order to test the hypothesis. Previously, the analysis prerequisite test was carried out, the results of the normality test using Lilliefors were obtained in the experimental class with $L_0 = 0.115$ and in the control class with $L_0 = 0.1076$. The critical value $L_{table} = 0.190$ which is taken from the list for the significance level = 5%. Thus, both the experimental and control classes show $L_0 < L_{table}$, which means that the sample comes from a normally distributed population. The results of the homogeneity test of the sample variance obtained the value of F_{hit}=1.82 and with =5% from the table it was obtained $F_{daf} = 2.02$. It turns out that $F_{hit} < F_{daf}$ which means that both data have the same variance (homogeneous). After being proven to be normal and homogeneous, the hypothesis was tested using the t test. The summary of the results of hypothesis testing can be seen in Table 6.

Table 6. Summary of Hypothesis Testing Results

Group	N	$\bar{x}$	S^2	S	S^2_{gab}	t_{hitung}	t_{tabel}
Experiment	23	74,34	267,06	16,34	380,72	4,46	1,68
Control	24	48,95	489,96	22,12			

Based on the data in Table 6, it can be seen that t_hit>t_daf, it can be said that the average mathematical problem solving ability using the Blended Learning model is higher than that using the Conventional learning model. Furthermore, to see the effectiveness of the Blended

Learning model on students' mathematical problem solving abilities, the relative efficiency formula is used, with a summary of the results in Table 7.

Table 7. Summary of Effectiveness Test Results

Group	**Varians**	$R(\theta_2, \theta_1)$
Experiment	267,06	0,55
Control	489,96	

Based on the data in Table 7, it is known that the value of $R(\theta_2, \theta_1) < 1$ that is $(0{,}55 < 1)$ then θ_1 is relatively more efficient than θ_2, it means that the Blended Learning learning model is effective in terms of students' mathematical problem solving abilities.

DISCUSSION

The application of Blended Learning during the research was carried out using learning that combines face-to-face learning in the classroom and in the network (online learning). Online learning uses Google Classroom which is used as a medium for independent learning, collaborative discussions, and provides learning resources as presentation material in class. Through e-learning media, teachers provide learning videos, e-books related to learning materials, and LKPD which are used during discussions and presentations in class. The results of online discussions are given reinforcement by the teacher during face-to-face learning. Achievements during online learning are also measurable through face-to-face learning, while the lack of face-to-face time in class is helped by online media that are used without limitations of space and time. The combination of face-to-face and online learning complement each other in meeting student learning needs. Blended Learning is proven to be effective on students' mathematical problem solving abilities. In line with the findings of Rahmawati & Mulbasari (2020) and Noviyanti, Sugiharta, & Farida (2019) that students' mathematical problem solving abilities using Blended Learning assisted by e-learning media are better than those using conventional learning. The results of research conducted by Sudiarta and Sadra (2016), Hima (2016), Palera, et al (2020) also give the same results, where there is a significant difference in mathematical problem solving abilities between the two groups (Blended Learning and conventional learning). The Blended Learning model can also motivate students in learning mathematics, by displaying attractive teaching materials in digital and non-digital forms.

The advantages of using online learning using e-learning media (google classroom) which can be accessed easily by students. Blended Learning makes it easy for students to repeat the learning as much as possible and adjust the learning time. In the application of Blended Learning, e-learning media can be used to provide various teaching materials and resources

according to creativity, ranging from learning videos, problem-solving-based student activity sheets, to other learning resources on the web. As stated by Nasution, Jalinus, and Syahril (2019) that the combination of various aspects of Blended Learning includes web, video streaming, audio, and communication with traditional learning. Of course this combination greatly facilitates students in learning. Of course this is in contrast to the control class that applies the conventional model, where teaching materials tend to use books. Teaching materials are considered less varied by students and this certainly affects their understanding.

Learning that uses Blended Learning presents an effective and efficient learning process. Opportunities for question and answer discussions that exist, are not limited to space and time. Of course this makes it easier for students to be able to express ideas, opinions, and construct their mathematical knowledge freely. Online discussions in this model also give students the opportunity to be able to learn more calmly, ideas or ideas that arise can be pondered first. This is why the achievement of learning objectives is maximized. This is in line with the nature of Blended Learning according to Nasution, Jalinus, and Syahril (2019) which states that the combination of behaviorism, constructivism, and cognitivism approaches in this model results in an optimal learning achievement. This is also supported by Ronsen, et al. in Oktaria, Budiningsih, and Risdianto (2018) that student learning outcomes increase after using the Blended Learning model. Of course this is different from conventional learning, class discussions show students' unpreparedness which results in the achievement of learning objectives which are also less than optimal.

The application of the Blended Learning model also has advantages when face-to-face is carried out. Face-to-face focuses on activities to strengthen concepts that have been obtained during online discussions and continue with problem solving activities. Multidirectional learning can be created well, students are given the opportunity to develop ideas based on the results of online discussions on presentation and problem solving activities. Learning is more focused and focused on things that are not understood during online discussions. Face-to-face activities can also be used to measure students' understanding of learning materials. Of course, students' understanding of learning materials is getting stronger with face-to-face activities. This situation is different from the control class that applies the conventional model, where students' understanding of the teaching material is still not optimal as seen from the mathematical problem solving activities carried out.

The combination of the Blended Learning model makes students active in expressing their mathematical ideas in multi-directional activities that are not limited by space and time. This model provides more experience to students than conventional learning. This model also

strengthens students' understanding of mathematics learning materials through well-structured and measurable teaching materials in face-to-face learning. Strong student understanding can certainly bring up various ideas and strategies in solving mathematical problems.

CONCLUSION

From the results of hypothesis testing followed by effectiveness testing, it was concluded that the application of Blended Learning was effective on the mathematical problem solving abilities of class VIII students at SMP Negeri 13 Bandar Lampung in the 2021/2022 academic year. Blended Learning also provides well-measured learning freedom and can hone students' creativity in pearly learning activities.

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